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Published in:
Pain Medicine

DOI:
[10.1111/pme.12528](https://doi.org/10.1111/pme.12528)

Publication date:
2014

Document Version
Early version, also known as pre-print

[Link to publication in ResearchOnline](#)

Citation for published version (Harvard):

Riskowski, JL 2014, 'Associations of socioeconomic position and pain prevalence in the United States: findings from the national health and nutrition examination survey', *Pain Medicine*, vol. 15, no. 9, pp. 1508-1521.
<https://doi.org/10.1111/pme.12528>

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**Associations of Socioeconomic Position and Pain Prevalence in the US: Findings from the
National Health and Nutrition Examination Survey**

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Type of article: Original Article (Full Paper)

Running Title: SEP and pain in the US

Abstract Word Count: 204

Number of Tables: 2

Number of Figures: 3

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Grant Support: None

Conflict of Interest: None

Abstract

Background: Pain is a significant burden within the United States (US) adult population, but

little is known regarding epidemiology of pain, particularly with respect to race, ethnicity and socioeconomic position (SEP).

Objective: The purpose of this study was to describe and evaluate prevalence and distribution of pain in the US.

Methods: With data from the population-based 2003-2004 National Health and Nutrition

Examination Survey (NHANES), prevalence of acute (< 3 months) and chronic (≥ 3 months) pain were evaluated, including subgroup analyses of race, ethnicity, and SEP, with SEP defined by the poverty-to-income ratio (PIR), a ratio derived from the federal poverty level, accounting for household income and number of household members.

Results: Prevalence of acute pain was 12.2% (95% confidence interval: 11.2-13.3%). Non-

Hispanic black as well as Hispanic and Mexican American individuals had higher rates of acute pain than non-Hispanic white people, and a higher prevalence was noted in those with higher SEP. Chronic pain prevalence was 15.6% (13.4-17.7%), with non-Hispanic white people had a higher prevalence than those in other racial and ethnic groups.

Conclusion: Trends of chronic pain by SEP were opposite of acute pain as those in the highest

SEP group tended to have less chronic pain than those in lower SEP groups. These findings suggest SEP in addition to race and ethnicity may play a role in the development of pain as well as its treatment and management.

Keywords: regional pain; socioeconomic status; health disparities; prevalence; health surveys

3-4 sentence article summary:

Little is known regarding epidemiology of pain with respect to socioeconomic position (SEP) in the US. This study evaluates US prevalence and distribution of pain by SEP along common demographic measures of gender, age, race and ethnicity using NHANES. Trends of chronic pain by SEP were opposite of acute as the highest SEP group had less chronic pain than the lowest. Findings suggest SEP may play a role in the development and treatment of pain.

Introduction

Worldwide chronic pain affects nearly one in three adults (1), and within the adult United States (US) population estimates of chronic pain range from 11% to 44% (2-5). Annually, costs associated with pain in the US are greater than that of heart disease, cancer, and diabetes (6), highlighting a need to understand pain in society.

Health status and health care differences exist for racial and ethnic minorities in the US (7), and with regard to pain this includes differences pain assessment, treatment, and outcomes (8-12). However, pain prevalence in the US by racial and ethnic categories have shown conflicting results, with some studies reporting non-Hispanic black and Hispanic or Mexican Americans individuals having higher rates (9, 13-15), whereas others show no difference or lower rates (5, 16), compared to non-Hispanic white people.

Hidden within these results is that often socioeconomic differences exist between groups in addition to racial and ethnic differences (7, 17), and the role of socioeconomic position (SEP) in health status and health care is only beginning to unfold in the US(18). Although health disparities have been shown along the racial and ethnic lines and although some have suggested that socioeconomic variables may play a role in pain prevalence, as other countries have noted (19-21), there is a paucity of results to support this claim in US pain studies (9).

As connections of health status exist between social strata and racial and ethnic categories, health reporting is to be examined along socioeconomic and racial and ethnic lines, jointly and separately (7). However, there is a gap in knowledge of pain prevalence along socioeconomic, racial and ethnic lines in the US. (19-21) (19-21) (19-21) (19-21) (19-21) (19-21) (19-21) Thus, the purpose of this study was to evaluate population-based prevalence rates of pain in the US by racial and ethnic categories as well as by SEP.

Methods

Survey and Sample Population

This analysis included data from the 2003-2004 National Health and Nutrition Examination Survey (NHANES). NHANES is a cross-sectional US population-based health and lifestyle survey of the non-institutionalized civilian household population and is conducted by the US National Center for Health Statistics, Centers for Disease Control and Prevention, with interviews and surveys conducted in English and Spanish.

NHANES participants were obtained through stratified, multistage probability sample design with unequal probabilities of selection. NHANES is a representative sample of the US non-institutionalized civilian household population with respect to gender, age, socioeconomic position, and rural/urban residence, with racial and ethnic minorities oversampled to ensure adequate representation. Individuals who are homeless, are institutionalized, or have a home without landline telephone were less likely to be included (complete collection procedures and analytic methods are available at www.cdc.gov/nchs.nhanes.htm).

For this analysis, participants for inclusion had to have an interview and clinical examination, be 18 years of age or older and have responded to the miscellaneous pain questionnaire. The study complies with the Declaration of Helsinki, the National Center for Health Statistics Ethics Review Board approved the protocols, and written informed consent was obtained.

Pain Assessment

The NHANES miscellaneous pain questionnaire collected information on the location and duration of self-reported pain. Participants were first asked if they had a problem with pain within the last month that had lasted at least 24 hours and was not “fleeting or minor.” Those

endorsing pain were asked about the duration they had been experiencing pain (<1 month, ≥ 1 month but <3 months, ≥ 3 months but <1 year, ≥ 1 year) and the body site affected. For this analysis, chronic pain was defined according to the American College of Rheumatology (ACR) criteria as pain of ≥ 3 months duration (22), whereas acute pain was noted as less than three months.

Pain location outcomes were coded as binary variables (present/not present), with the following six pain regions evaluated from the miscellaneous pain questionnaire:

- (a) head and/or face pain,
- (b) neck pain,
- (c) back pain (included right or left lower or upper back, or spine),
- (d) upper extremity pain (included right or left shoulder, upper, mid, or lower arms, or hands),
- (e) chest and/or abdominal pain (included right or left chest, sternum, and abdominal), *and*
- (f) lower extremity pain (included right or left buttock, upper, mid, or lower legs, or feet).

Presence of chronic widespread pain was also evaluated. Chronic widespread pain was defined as pain experienced for three or months above and below the waist, on both the right and left side of the body, and at an axial location (spine, chest, sternum, upper or lower back), in line with the ACR definition of chronic widespread pain (22).

Additionally, a multilevel variable for number of pain regions per participant was created. This variable counted the number of regions of pain, with the regions being:

- (a) head and/or neck pain (head, face or neck),
- (b) right upper extremity pain (right shoulder, upper, mid, lower arm, or hand),
- (c) left upper extremity pain (left shoulder, upper, mid, lower arm, or hand),

- (d) ventral torso pain (right or left chest, sternum or abdominal),
- (e) dorsal torso pain (right or left upper or lower back),
- (f) right lower extremity pain (right buttock, upper, mid, or lower leg, or foot), *and*
- (g) left lower extremity pain (left buttock, upper, mid, or lower leg, or foot).

The number of regions affected with chronic pain were summed per participant, and a four-level number of pain sites variable was created as: no pain (referent), 1-2 regions of pain, 3-4 regions of pain or 5 or more regions of pain.

Socioeconomic Position

Socioeconomic position (SEP) was defined by using data from the family poverty income ratio (PIR). PIR is calculated as annual family income divided by the federal poverty line, is adjusted each calendar year for inflation, varies by number of people in the household, and is based on criteria from the US Census Bureau (23). In this analysis, three groups were created based on the PIR. These groups were $PIR \leq 1$, $PIR > 1$ to < 2 , and $PIR \geq 2$ (24). A PIR of “ ≤ 1 ” is defined as a household being at or below the official federal poverty threshold. PIR of “ ≥ 2 ” is defined as a household being at least double the poverty threshold and was the reference group. This three-level categorization of PIR is an established measure of SEP in US (24).

Race and Ethnicity Classification

Race and ethnicity were categorized as: (i) non-Hispanic White, (ii) non-Hispanic Black and African American, (iii) Mexican-American and Other Hispanic Americans, *and* (iv) Other, which included those who reported more than one race, similar to prior work (5).

Other Covariates

In addition to gender, self-reported age in years, smoking status, alcohol intake, physical activity level, employment status, and health insurance coverage were included as covariates.

Body mass index (BMI) was also a covariate and determined from the physical examination using standardized protocols and calibrated equipment as weight in kilograms divided by the square of height in meters.

Smoking Status

Smoking status was categorized into never smoked, former smoker, and current smoker. Participants who had not smoked more than 100 cigarettes or 20 cigars or had not used a pipe more than 20 times in his or her life were considered to have never smoked. A former smoker was a participant who had smoked more than 100 cigarettes or 20 cigars or had used a pipe more than 20 times in his or her life, but was not currently doing so, whereas a current smoker was currently using cigarettes, cigars or pipes. These definitions are in line with the US Center for Disease Control classification of smoking status (25).

Alcohol Intake

Determination of alcohol intake was defined through a calculated average of number of drinks per week, where one drink was equivalent to one beer (12 fl oz/355 mL), one glass (4 oz./118 mL) of wine, or one shot (1 oz./30mL) of liquor. Those who drank less than 12 drinks over their lifetime were classified as “Never”; those who had drank more than 12 drinks over their lifetime, but none in the prior 12 months were classified as “Former Drinkers”; participants who had drank on average less than 3 drinks per week were classified as “Light Drinkers”. Moderate and heavy drinking was based on gender and by age in men. Women and men 65 years of age and older who reported drinking three to seven drinks on average per week, and men under 65 years of age who drank three to fourteen drinks on average per week were classified as “Moderate Drinkers.” “Heavy Drinkers” were women or men 65 years of age or older who reported drinking more than seven drinks on average per week or were men under 65 years of

age who reported drinking more than fourteen drinks on average per week. These cut-points are based on recommendations set by the US National Institute on Alcohol Abuse and Alcoholism (26).

Physical Activity

Physical activity level was set based on responses in the questionnaire related to daily activities, leisure-time activities, and sedentary activities. Daily activities were measured as the frequency and duration of activities related to transportation such as walking and bicycling, noted as active transport, and doing moderate tasks around the home or yard over the past 30 days. Participants were asked to report the frequency and the duration that they spent participating in various leisure-time physical activities of moderate or vigorous intensity (physical activities of light intensity were not reported) over the past 30 days. To represent the physical activity of individuals, the average daily total metabolic equivalent (MET) weighted minutes spent performing moderate to vigorous physical activities, time in active transport, and time in moderate household activities over the past 30 days. The daily average time spent on these activities was calculated by summing the MET-weighted minutes for each activity, divided by 30 days. These physical activity values were cut into tertiles to provide representation of physical activity (27).

Employment Status

Data from the occupational questionnaire were used to classify participants' employment status. Participants who reported they who said they were "working at a job or business" and worked 35 hours or more in the week prior to the interview or who stated they usually work over 35 hours per week were considered employed full-time. Participants were "working at a job or business" and reported working 1-34 hours in the prior week or reported they usually work less

than 35 hours were considered employed part-time. These classifications are in line with the U.S. Bureau of Labor Statistics (BLS) definitions (28).

There were three not employed categories. Participants who said they were “looking for work” or were “laid off” were classified as “Not employed, looking for work.” Participants who reported they were not employed, but were “retired,” “taking care of house or family,” or “going to school” were classified as “Not employed, not looking for work.” The third classification was for participants who reported they were “unable to work for health reasons” or were “disabled” were classified as “Not employed, unable to work.”

Health Insurance Coverage

Health insurance coverage was determined through the queries regarding type of health insurance or duration without insurance. Participants who reported not having health insurance were delineated as being without insurance for less than one year or without insurance for more than one year. Participants who reported they were covered were queried regarding if the insurance was by private insurance or by a public and government entity (e.g., Medicare, Medicaid) and were classified accordingly. If participants had both private and public or government sponsored insurance, they were classified as having private insurance coverage. This categorization of health insurance coverage is similar to prior studies of health care utilization and health insurance coverage (29, 30).

Data Analysis

Unweighted means and percents were calculated to describe the demographic and pain outcomes for the NHANES sample, with weighted means and percents calculated for estimates for the total United States population. The data were weighted using the 2-year (2003-2004) weight strata and masked variance units (pseudo-primary sampling unit [PSU]) variables

available in the NHANES public release data. All analyses were performed using R version 3, with inferential data calculated with the complex survey design package, which uses the Taylor series method to calculate properly weighted variance estimate. Statistical significance was set to $p \leq 0.05$.

Subgroup analysis evaluated pain outcomes by age, with the calculated prevalence estimates by socioeconomic position for the chronic pain locations and number of pain regions, as well as for the type of pain (i.e., acute, chronic regional, or chronic widespread), stratified by gender. A second subgroup analysis evaluated chronic and widespread pain by racial and ethnic group, with calculated prevalence estimates by SEP position and stratified by gender. Inferential prevalences are presented as point estimates with 95% confidence intervals. In these subgroup analyses a Cochran-Armitage test for trend was used to evaluate the changes by socioeconomic group. Chi-squared test between genders, between the racial and ethnic categories, and between the SEP groups, using non-Hispanic white men or women as the reference, was performed for each type of pain, accounting for multiple comparisons using a Bonferroni correction.

Logistic regression models were used to evaluate the associations between SEP and type of pain as well as region of chronic pain. To evaluate number of pain regions gender-specific multinomial logistic regression models were used. All regression models are presented as a crude model with three adjusted models. Adjusted model 1 accounted for demographic features of age in years as a quadratic term (31), BMI (32), and racial and ethnic category (5). Adjusted model 2 included variables from the first model as well as lifestyle variables of smoking status (33), alcohol intake (34), employment status (35), and physical activity (36). Adjusted Model 3 included variables from the first two models, adding in health insurance coverage (35). The referent for all regression models were participants classified was $PIR \geq 2$.

Results

Of the 18,207 participants included in the NHANES study, 17,517 participants had an NHANES interview or examination. There were 7,533 excluded for being less than 18 years of age and 1,714 excluded due to lack of response on the pain questionnaire, leaving 8,270 participants included for this analysis.

As the NHANES survey oversample racial and ethnic minorities, the sample contained higher percentages of non-Hispanic black people (20% vs. 11%), Hispanic and Mexican Americans (19% vs. 10%), and a lower percentage of non-Hispanic white people (57% vs. 76%) when compared to the weighted inferential statistics of the US general population (Table 1).

Poverty-to-income ratio (PIR) was used to delineate socioeconomic position (SEP). The sample population had a lower percentage of individuals in the highest SEP of $PIR \geq 2$ (61% vs. 71%), with more in the middle SEP group of $PIR > 1$ to < 2 (23% vs. 18%) and lower SEP group of $PIR \leq 1$ (16% vs. 11%) compared to the general US population.

The sample population prevalence estimates for acute pain was 11.2%, with a US weighted estimate of 12.2% (95% confidence interval [95% CI]: 11.2-13.3%) with women having a higher prevalence rate than men (13.0% [95% CI: 10.8-15.2%] vs. 11.4% [95% CI: 9.0-13.8%], supplemental data Table 1). Prevalence rates for acute pain was higher in the highest SEP ($PIR \geq 2$) group compared to the lowest SEP ($PIR \leq 1$) group (12.6% [95% CI: 10.8-14.4%] vs. 11.5% [95% CI: 8.5-14.5%]).

The point prevalence of chronic pain in at any location within the sample population was 14.5%, and the weighted estimate was 15.6% (95% CI: 13.4-17.7%), with women having a higher prevalence rate than men (18.3% [95% CI: 15.1-21.5%] vs. 12.9% [95% CI: 9.8-16.1%]). Within the SEP groups, the highest SEP group had a lower prevalence rate of chronic regional

pain compared to the lowest SEP group (14.3% [95% CI: 11.7-16.8%] vs. 20.9% [95% CI: 14.0-27.5%]).

Chronic widespread had a point prevalence of 4.2% within the sample population, with a US weighted estimate of 4.7% (95% CI: 3.3-6.0%), with women having a higher prevalence rate than men (5.8% [95% CI: 3.8-7.7%] vs. 3.6% [95% CI: 2.2-5.0%]). Similar to chronic regional pain, chronic widespread pain was lower in the highest SEP group compared to the lowest SEP group (3.8% [95% CI: 2.6-5.0%] vs. 8.8% [95% CI: 5.6-12.1%]).

Of the seven pain regions evaluated, the highest US population prevalence estimates for chronic pain at specific body regions was for the back at 8.2% (95% CI: 6.6-10.7%), followed by the lower extremities at 8.0% (95% CI: 6.4-10.1), and upper extremities at 5.9% (95% CI: 4.7-7.3).

Pain by Gender, Racial & Ethnic Group, and Socioeconomic Position (SEP)

Between genders, non-Hispanic white and Hispanic and Mexican American women had higher rates of acute pain compared to their male counterparts (Figure 2; supplemental data Table 2). Comparing between racial and ethnic groups, acute pain was reported more in non-Hispanic black men, Hispanic and Mexican American men and other racial/ethnic groups than in non-Hispanic white men, with no difference in acute pain between the racial and ethnic groups in women. When evaluating the trend of acute pain by SEP group, there was a statistically significant decrease in prevalence of acute pain with a lower SEP in both men and women. However, within the racial and ethnic groups, this trend of decreasing rate of pain with lower SEP was only seen in the Hispanic and Mexican American men and women.

In chronic regional pain, women had a higher rate than men, with women also showing a statistically significant trend of increasing rates of chronic regional pain with a lower SEP. In

evaluating the subgroups, non-Hispanic white men and women as well as non-Hispanic black women also showed a trend of increasing rates of chronic regional pain with a lower SEP.

Further, compared to non-Hispanic white men or women, non-Hispanic black and Hispanic and Mexican American men and women reported less chronic regional pain, which was also noted within the individual SEP groups.

Although women reported more chronic widespread pain than men, subgroup analysis showed this was between men and women who self-identified as non-Hispanic black or Hispanic and Mexican American. In evaluating SEP with chronic widespread pain, there was a statistically significant trend for a higher rate of chronic widespread pain with a lower SEP, and this was noted in the overall analysis of both men and women as well as in non-Hispanic white men and women. When comparing rates within SEP categories by race and ethnicity, non-Hispanic black men as well as Hispanic and Mexican American men and women reported lower rates of chronic widespread pain relative to their non-Hispanic white counterparts.

Pain Prevalence Estimates by Gender, Age, and Socioeconomic Position

For all participants, there was no statistically significant age-group related trend in acute pain or chronic regional pain; however in men and women chronic widespread pain showed an increasing trend over the age groups.

Acute pain rates were similar between men and women at all age-groups, with women in the youngest age group (18-39 years), men in the middle age group of 40-64 years and men and women in the oldest age group (85 years or older) showing a trend for decreasing pain rates with a lower SEP (Figure 2; supplemental data Table 3).

Converse to this, men and women reported different rates of chronic regional pain in the three age groups of 18-39 years, 40-64 years and 65-84 years of age. Further, a statically

significant increase with the rates of chronic regional pain with a lower SEP was noted in men and women between the age of 40 to 64 years as well as in men 85 years of age and older. Within women age 85 years of age and older, there was a decreasing rate of chronic widespread pain with a lower SEP.

With regard to chronic widespread pain, women in the age groups of 40-64 years and 65-84 years of age reported greater rates of chronic widespread pain than their male counterparts. Within the middle age group of 40-64 years, men and women both had a statistically significant trend of increasing rates of chronic pain with a lower SEP, which was also noted in women aged 64-85 years of age.

Regression Models of Pain to Socioeconomic Position (SEP)

In men, both crude and adjusted logistic regression models showed a reduced risk of acute pain for those in the lower SEP groups (i.e., $PIR >1$ to <2 and $PIR \leq 1$) relative to those in the highest ($PIR \geq 2$), whereas only women in the middle SEP group ($PIR >1$ to <2) showed a reduced risk (Table 3, supplemental data Table 4). With regard to chronic regional and widespread pain, the crude and adjusted models showed an increased risk in the lower SEP groups in men and only in the lowest SEP group for women ($PIR \leq 1$).

In both the crude and fully adjusted model, the lower SEP groups showed increased odds of upper extremity and back pain in men, which was also noted in men in the middle SEP group ($PIR >1$ to <2) for lower extremity pain and in women in the lowest SEP group ($PIR \leq 1$) for upper and lower extremity and back pain. There was also an increased odds of lower extremity pain in the lowest SEP group in fully adjusted model. Further, men in the lowest SEP showed an increased odds of chest and/or abdominal pain (2.3% [95% CI 1.0-4.6%]) in the crude model, which after adjustment showed no significant differences. Converse, women in the lowest SEP

group after adjusted had reduced odds of chest and/or abdominal pain (0.3% [95% CI: 0.1-0.8%]). There were no differences in odds of pain at the head and/or face or neck in men or women.

In the multinomial regression of number of pain regions, the fully adjusted model showed men in the lowest two SEP groups had increased odds of pain, regardless of the number of pain sites (Figure 3, supplemental data Table 5). In women, those in the lowest SEP group showed an increase in risk of number of pain sites, whereas those in the middle SEP group had an increase only in five or more regional sites of pain.

Discussion

The purpose of this population-based study of pain was to evaluate if differences in pain prevalence exist in the US with respect to socioeconomic position (SEP) groups and racial and ethnic categories, both jointly and separate. The principal finding from this study was the reverse trends of acute and chronic pain as they related to the SEP grouping within the racial and ethnic categories. Non-Hispanic black people and Hispanic and Mexican Americans tended to have higher rates of acute pain compared to non-Hispanic white people, and those with a higher SEP tended to have a high rate of acute pain in comparison to those with a lower SEP. Conversely, non-Hispanic black people and Hispanic and Mexican Americans tended to have a reduced prevalence of chronic regional and widespread pain relative to non-Hispanic white people, with a lower SEP giving rise to an increased odds of chronic musculoskeletal pain. Finally, the relations of SEP and pain were most notable in the large musculoskeletal groups of back and upper and lower extremities. The reverse pattern between acute and chronic pain with regard to SEP aligns with the theory of multifactorial etiology of pain where physical and neurobiological factors interact with psychological and social factors (37, 38), which highlights a need for population-

level longitudinal studies to evaluate the development, management and treatment of pain in order to reduce the impact of pain on society.

Prior studies in the US have suggested that there may be an underlying biological and cultural plausibility for race and ethnicity differences in pain tolerance (39, 40) and reporting (41, 42) with non-Hispanic black people and Hispanic and Mexican American typically reporting lower pain tolerance relative to non-Hispanic white people; however, this is not always the case (5, 16). In this study, which included both acute and chronic pain, non-Hispanic white people reported less acute pain than other races and ethnicities, whereas in chronic pain non-Hispanic white people reported experiencing more chronic pain than other races and ethnicities. As these results are cross-sectional and not longitudinal, the underlying causes of these differences by racial and ethnic group in acute and chronic pain are unknown. However, cross-sectional studies of US veterans noted that Hispanic veterans and non-Hispanic black veterans were more likely to report and receive treatment for pain relative to non-Hispanic white veterans (10).

Even as there were noted differences in pain prevalence by race and ethnicity, across the SEP spectrum within these racial and ethnic groups there were similarities of pain prevalence. A trend of higher rates of chronic pain with a lower SEP was noted, results in line with studies outside the US (20, 43, 44). Of studies that have noted a relationship between SEP and chronic pain, the back seem particularly vulnerable to chronic pain with individuals of a lower SEP (20, 43-45). In this study, men in the lower two categories of SEP displayed a greater odds of back pain, even after adjustment, whereas only women in the lowest SEP displayed a greater odds of back pain. This pattern was also found in chronic pain of the upper and lower extremities, such that men in the lower two categories of SEP had a greater odds of pain, whereas only the lowest SEP category in women showed an increased odds of pain.

Some authors suggest that there is a SEP gradient pattern for health outcomes, which gives rise to the idea that there may dose-response relationship of health status with SEP (7). Moreover, a dose-response relationship is a criterion for inferring causality (46). The results of the Cochran-Armitage trend test showed trends of increasing rates of pain within specific age groups (40-64 years most notably) and within racial and ethnic groups. These findings complement the growing body of literature, which includes delineating pathways and physiological mechanisms that link race, ethnicity, and SEP to pain, suggesting that causal roles of pain associations to SEP may be factors connected to income, employment, social status, and education (34, 47, 48). While each of factors these on its own may not be a direct pathway in development of pain or in management of pain, or lack thereof, it is well known that these factors together can create access to vital, influential, and extensive resources and opportunities to impact health and health behaviors (49, 50).

Further, reverse causation, whereby poor health and increased pain leading to lower SEP, may explain some of the observed SEP effects with pain. Even though this was a cross-sectional study and although a longitudinal study would provide a better understanding of the course of pain within the different SEP, racial, and ethnic categories, acute pain, be it idiopathic, from overuse, or from an accident or injury, if not addressed and treated appropriately, can lead to chronic pain (37, 51-53) and disability (37, 54). This study had a reverse relation of SEP to acute and chronic pain, in that at the acute stage there was less pain amongst those at the lower SEP category, but in the chronic stage there was more pain in those with a lower SEP. As pain affects performance-based work more than absenteeism and medical treatment combined (55), over time could affect an individual's income (56), and although it is speculative, the results shown could be related to changes in SEP over time as acute pain become chronic. Accordingly, the novelty of this work lays in the inclusion of acute pain and its associations to SEP in order

to provide a more complete understanding of pain within the US population.

As with any study, there are strength and limitations of the work. This study is cross-sectional in nature, and as such, cannot provide definitive link of pain to race, ethnicity and SEP, and the causal pathway of these associations are unknown. Further, as pain was queried through a personal interview, the results may not be directly comparable to other studies of pain that use different formats, such as postal-based (57) or Internet-based (58) studies (59-61). Evaluation of pain as acute or chronic pain by duration is common (22), and this study does not account for sub-acute pain, which based on the current definition would be pain self-reported as “fleeting or minor” or lasting less than 24 hours. Moreover, the three-level delineation of SEP, which is an established categorization of poverty-to-income (PIR) in US (24), may show different effects using different cut-points. As many public assistance programs (e.g., Medicare, housing allowances) and are based on PIR cutpoints this was the chosen measure for SEP, and in order to compare across other studies of SEP in other health care fields (e.g., type 2 diabetes (62), sexual health (63)), these cut-points of $PIR \leq 1$, $PIR >1$ to <2 , and $PIR \geq 2$ were used. Correspondingly research has suggested the cut-points of SEP along racial and ethnic lines may differ (64) and the interaction of race and ethnicity to SEP may affect health (65); as such further work evaluated the role of race, ethnicity and SEP is necessary to determine if this is the case with regard to pain. Strengths of this study includes it participants, which are representative sample that included a relatively large number of participants with acute pain, chronic regional and chronic widespread pain. The high participant number and mix of participants may be more broadly generalizable than those of previous studies. Further, this study is the first to evaluate relations of acute, chronic regional and chronic widespread pain to SEP, race and ethnicity in the US, providing a descriptive analysis of pain, while also further exposing the need for longitudinal studies of pain

within these demographic groups.

In conclusion, inequalities in health and pain are determined by a number of variables and differences in lifetime exposure to various factors, and the pattern noted between acute and chronic pain with respect to SEP necessitates tracking pain from the acute stages in order to identify the underlying elements that affect pain management and treatment within the socioeconomic strata. Thus, longitudinal data including socioeconomic and lifestyle factors as well as the course of pain development, management and treatment are essential, as inequalities in health are dynamic, particularly within the US where there is a mix of privatized and public health care that can change with age and employment. As increasing gradients of SEP widening health inequalities (66), which consequently can relate to cultural shifts that lead to changes in behavioral risk factors, such as change in diet, obesity (67), and health (68), there is a need to understand and address pain development, management, and treatment as it sits within society's social, economic, and health care policies.

Disclosures:

Funding: None

Conflict of Interest: None

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